

REMARKS

Claims 1-20 are currently pending in the application. By this amendment, claims 1 and 11 are amended for the Examiner's consideration. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully requested.

Allowed Claims

Applicants appreciate the indication that claims 17-20 are allowed. Applicants further note that none of the claims were rejected in view of prior art. In view of this fact, Applicants submit that all of the claims contain allowable subject matter and should be passed to issuance upon overcoming the 112, 2nd paragraph rejection. As the objection and 112, 1st and 2nd paragraph rejections should now be withdrawn, in view of the below comments, Applicants submit that all of the claims are in condition for allowance.

35 U.S.C. §112 Rejection, 2nd Paragraph

Claims 1-16 were rejected under 35 U.S.C. §112, 2nd paragraph. This rejection is respectfully traversed.

In an attempt to advance prosecution, Applicants have amended claim 1 to delete the terminology "forming" of the memory layer. Applicants submit that this broadens the claimed invention and also renders the claim clear and definite when read in view of the specification. Applicants have amended claim 11 to provide proper antecedent basis, by amending "material" to "layer".

According to MPEP §2173.02, the test for definiteness under 35 U.S.C. 112, second paragraph, is whether "those skilled in the art would understand what is claimed when the claim is read in light of the disclosure." *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1576, 1 USPQ2d 1081, 1088 (Fed. Cir. 1986). Definiteness of claim language must be analyzed, not in a vacuum, but in light of: (A) the content of the particular application disclosure;

(B) the teachings of the prior art; and (C) the claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made.

Memorizing

The term “memorizing” is clearly defined in the specification and, as such, is not indefinite or vague. More specifically, the specification is replete with instances of memorizing and, in fact, provides at least one instance of an alternative use of the term memorizing, i.e., copy. Particularly, the following passages of the specification define, in the context of the specification, the use of memorizing.

[0015] The invention is directed to employing non-critical lithographic techniques using a memory layer of material to memorize edges of a masking material to define a final structure having improved tolerances.

[0023] The chemical-block material 16 is used to memorize or copy a first edge of the final structure as defined by a resist layer 18. The resist layer 18 is printed, imaged and patterned, on top of the chemical-block 16, leaving exposed regions of the chemical-block 16.

[0026] Referring to FIG. 3, after the hardmask 20 and the sacrificial material 22 are formed, an undercut 24 is formed in the sacrificial material 22 and beneath the hardmask 20. The edge of the hardmask 20 does not move during the undercut process, and the edge E_{out} is thus memorized for use in subsequent steps. The undercut 24 is preferably formed by a chemical oxide removal (COR); however, a buffered HF etch may also be used to form the undercut. The width of undercut 24 corresponds to the desired final well-controlled linewidth. In one implementation, the COR process provides an undercut in the range of 50 Å to 500 Å. In one embodiment, a 300 Å undercut may be provided for Semiconductor Industry roadmap 65 nm-generation processing. It should be understood, that the COR process is repeatable and, as such, the undercut can be repeated to fabricate larger dimensions. Also, other dimensions are contemplated by the invention, depending on the desired linewidth of the final structure.

[0029] In FIG. 5, a directional RIE process is used to remove selected portions (e.g., unprotected) of the nitride layer 28. This process should not remove the capping material 20, although portions of the capping material 20 may be sacrificed if the thickness of the capping material 20 remaining after RIE processing is sufficient to maintain a well-defined edge E_{out} . The directional RIE process is controlled to ensure that the edges of the material remain intact, e.g., are not eroded. The capping layer 20, during this RIE process, protects the inner edge E_{in} of the nitride layer 28 and defines the outer edge E_{out} in the nitride layer 28. Both edges E_{out} and E_{in} are thus memorized. If the edge of the capping material such as Ge is eroded during the RIE, then the edge of the nitride 28 will also be damaged, thus sacrificing the patterning of the final structure.

In view of the above, Applicants submit that the recitation "memorizing" is clear and definite when read in light of the specification.

Memory Material

Applicants submit that the memory material forms the memory layer. This is clear and definite and is clearly described in the specification.

Claims 2, 11, 13 and 14

The Examiner is of the opinion that the protection sought for the underlying material in claim 2 and the protective layer in claims 11, 13 and 14 is indefinite since the specification fails to provide support for such claiming. Applicants disagree with the Examiner.

Applicants note that these features are shown in at least figure 2 and at paragraphs [0024]-[0029] of the published application. More specifically,

Figure 2 shows a structure in accordance with the invention after etching processes. In particular, the chemical-block 16 and underlying oxide layer 14 are removed by a selective directional etching process. In one implementation, a standard reactive ion

etching (RIE) may be used in which the resist layer 18 acts as a RIE mask. In this process, the chemical-block 16 and oxide layer 14 are etched (with the resist layer 18 acting as a mask) and then the resist layer 18 is stripped. By way of one example, a standard oxide etch based on chlorine (Cl_2) or hydrogen bromide (HBr) may be used to selectively etch the chemical-block 16. In another etching process, a fluorine-based etch may be used to etch away the oxide (SiO_2) layer 14, to the substrate 12. It should be understood that the chemical-block 16 such as Ge may be used to "firm" up the edge, which will be transferred to the SiO_2 layer as shown at E_{out} .

Still referring to FIG. 2, as a result of the etching process, the chemical-block layer 16 has been patterned and now forms a capping material, referred to as a hardmask 20. Additionally, the oxide layer 14 has also been patterned with the image of the photo resist 18 forming a sacrificial layer 22.

Referring to FIG. 3, after the hardmask 20 and the sacrificial material 22 are formed, an undercut 24 is formed in the sacrificial material 22 and beneath the hardmask 20. The edge of the hardmask 20 does not move during the undercut process, and the edge E_{out} is thus memorized for use in subsequent steps. The undercut 24 is preferably formed by a chemical oxide removal (COR); however, a buffered HF etch may also be used to form the undercut. The width of undercut 24 corresponds to the desired final well-controlled linewidth. In one implementation, the COR process provides an undercut in the range of 50 Å to 500 Å. In one embodiment, a 300 Å. undercut may be provided for Semiconductor Industry roadmap 65 nm-generation processing. It should be understood, that the COR process is repeatable and, as such, the undercut can be repeated to fabricate larger dimensions. Also, other dimensions are contemplated by the invention, depending on the desired linewidth of the final structure.

In one exemplary embodiment, the amount of undercut removal is determined by the COR process parameters (temperature, pressure and reactive concentration). For example, varying the temperature will vary the undercut depth. This COR process results in a solid by-product which is removed by sublimation or H_2O wash to complete the COR cycle. The

undercut 24 leaves an overhang 26 of the hardmask 20, comprising Ge, for example. The exposed substrate layer 12 is material to be later etched in accordance with the invention.

Referring to FIG. 4, after the undercut 24 is formed, a memory material such as a nitride layer 28, for example, is conformally formed over the hardmask 20, within the undercut 24 and over the exposed substrate layer 12. The nitride layer 28 will be used as a memory material in accordance with the invention to pattern the critical film. And, although nitride is preferred, this material may include any suitable material, for example, polycrystalline silicon or tungsten. The material deposited underneath the overhang 26 within the undercut 24 preferably has good conformality and gap-filling properties to fully fill the undercut 24. The memory material such as the nitride may be conformally deposited using, for example, silane and ammonia, or plasma enhanced chemical vapor deposition (CVD) process. Additionally, the nitride, for example, is capable of masking the etch employed to pattern the critical film (substrate) in later processing steps as described below.

In view of the above, Applicants submit that the recitation of the features of claims 2, 11, 13 and 14 are clear and definite when read in light of the specification.

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CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicant hereby makes a written conditional petition for extension of time, if required. Please charge any deficiencies and credit any overpayment of fees to Attorney's Deposit Account No. 09-0456.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Andrew M. Calderon", with a long horizontal flourish extending to the right.

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